

REMARKS

Applicants respectfully traverse the objections and rejections provided in the Office Action mailed June 3, 2005 (hereinafter "Office Action") for at least the reasons discussed below.

Overview

As discussed in the Background of the Invention section of the present application, some UPS systems, e.g., "line interactive" UPS systems, use an architecture in which an AC voltage is generated from a DC voltage on a DC link. Some embodiments of the invention arise from a realization that a shifting or modulation of the range spanned by the DC voltage of busses of the link with respect to an AC output neutral or other reference can improve conversion efficiency and/or reduce voltage stress in power conversion circuitry. Such operations are described, for example, in FIGs. 9B-9E and the accompanying description thereof, which illustrate how a voltage range between DC busses may be shifted such that the magnitude of the range between the busses may be kept lower over an operational envelope in comparison to a conventional converter. In some embodiments, by employing such bus range shifting techniques, the relative magnitudes of DC voltages of busses of a DC link can be maintained substantially in proportion to the relative magnitudes of minimum and maximum phase voltages of an AC output such that one pole of a polyphase converter used to generate the AC output need not switch (discontinuous modulation).

In some embodiments of the present invention, a power converter apparatus includes first and second DC voltage busses and a polyphase DC to AC converter circuit coupled to the first and second DC voltage busses and operative to generate a polyphase AC output. The apparatus further includes a control circuit operatively associated with the polyphase DC to AC converter circuit and *configured to shift a DC voltage range of the first and second DC voltage busses with respect to a reference voltage responsive to a relationship among phase components associated with the polyphase AC output*. In further embodiments, an uninterruptible power supply (UPS) includes first and second DC voltage busses, a DC source operative to supply power to the first and second DC voltage busses, and a polyphase DC to AC converter circuit coupled to the first and second DC voltage busses and operative

to generate a polyphase AC output. A control circuit is operatively associated with the polyphase DC to AC converter circuit and *configured to shift a DC voltage range of the first and second DC voltage busses with respect to a reference voltage responsive to a relationship among phase components associated with the polyphase AC output*. In some method embodiments of the present invention, *a voltage range between first and second DC voltage busses is shifted with respect to a reference voltage for a polyphase AC output produced by a polyphase converter responsive to a relationship among phase components associated with the polyphase AC output*.

The title is descriptive

The Office Action asserts that the title is not descriptive. Office Action, p. 2. Applicants respectfully disagree, as the above discussion clearly indicates that embodiments of the invention provide power conversion apparatus and methods that employ DC bus shifting. As the Office Action provides no further explanation as to why the title is allegedly not descriptive, Applicants request that the objection to the title be withdrawn or clarified.

Independent Claims 1, 20 and 29 are patentable

Independent Claims 1-38 stand rejected under 35 U.S.C. § 102 as being "clearly anticipated" by U.S. Patent No. 6,324,085 to Kimura et al. (hereinafter "Kimura"). Office Action, p. 2. In rejecting these claims, the Office Action limits the grounds provided to a conclusory statement that "Kimura discloses a DC voltages busses a (sic) with control circuit that is used to shift the DC voltage with respect to a reference voltage responsive to a reference voltage (sic) responsive to a relationship among the phase components in a UPS circuit using PWM modulation circuitry" and cites FIG. 5 of Kimura. Office Action, p. 2. Applicants respectfully traverse these rejections, at least as Kimura has nothing to do with bus shifting as recited in the claims.

Described beginning at column 12, line 47 of Kimura, FIG. 5 illustrates a three-phase inverter used to drive a motor 9. A three-phase bridge including a plurality of insulated gate bipolar transistors (IGBTs) 1-6 is coupled between positive and negative DC power rails 7a, 7b. A battery 8 maintains a DC voltage between the DC power rails 7a, 7b. A control circuit

including a command value generator 10, a command value converter 21, a PWM waveform generator 11 and a driver 15 controls the IGBTs 1-6 responsive to "a signal representative of the detected phase (the detected rotation angle) θ of a rotor in the three-phase AC motor 9." Kimura, column 13, lines 23-25.

The Office Action provides no specific indication as to where FIG. 5 and/or the description thereof indicates, for example, that the control circuitry shown in FIG. 5 is "configured *to shift a DC voltage range* of the first and second DC voltage busses *with respect to a reference voltage* responsive to a relationship among phase components associated with the polyphase AC output," and Applicants submit that Kimura is devoid of such teachings. Accordingly, Applicants submit that Kimura fails to disclose or suggest all of the recitations of Claim 1, and that the rejection of independent Claim 1 should, therefore, be withdrawn for at least these reasons. Applicant further submits that the rejections of independent Claims 20 and 29 are erroneous for at least similar reasons and should also be withdrawn. If the present rejections of the independent claims are maintained in a subsequent office action, Applicants respectfully request a specific indication, for example, a column/line citation, as to where Kimura provides the teachings discussed above.

The dependent claims are patentable

Applicants submit that the dependent claims are patentable at least by virtue of the patentability of the various ones of independent Claims 1, 20 and 29 from which they depend. Applicants further submit that many of the dependent claims are separately patentable.

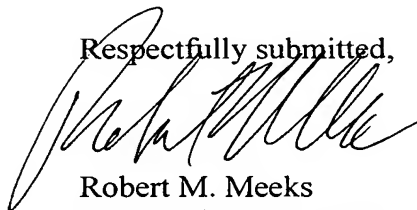
Applicants note that several of the dependent claims recite various techniques whereby bus range shifting as recited in the independent claims may be implemented. For example, Claims 2-4 recites various types of reference voltages that may be used. Claim 6 recites "wherein the control circuit is configured to shift the DC voltage range of the first and second DC voltage busses with respect to the reference voltage *responsive to phase modulation commands from which the polyphase AC output is generated*." Claim 8 recites "wherein the polyphase DC to AC converter circuit comprises respective half-bridge circuits that drive respective phases of the polyphase AC output, and wherein the control circuit is operative *to provide discontinuous modulation* of at least one of the half-bridge circuits."

Claim 10 recites "wherein the control circuit is operative to shift the DC voltage range between the first and second DC voltage busses *responsive to a relationship among phase components associated with the AC input and the polyphase AC output.*" Several other dependent claims cite various other separately patentable features.

The Office Action provides no specific indication as to where Kimura allegedly teaches or suggests these and other features of the dependent claims, and Applicants submits that Kimura is devoid of such teachings. Applicants, therefore, submit that the rejections of the dependent claims are erroneous and should be withdrawn. Applicants defer further discussion of the separate patentability of the dependent claims until such time as specific evidence as to where Kimura and how or other prior art teaches the recitations of the dependent claims is provided.

Conclusion

Applicants respectfully request withdrawal of the objections and rejections in the Office Action for at least the reasons discussed above. Applicants submit that the claims and specification are in condition for allowance, and request allowance of the claims and passing of the application to issue in due course. Applicants encourage the Examiner to contact the undersigned by telephone to resolve any remaining issues.

Respectfully submitted,

Robert M. Meeks
Registration No. 40,723
Attorney for Applicant(s)

USPTO Customer No. 20792
Myers Bigel Sibley & Sajovec
Post Office Box 37428
Raleigh, North Carolina 27627
Telephone: 919/854-1400
Facsimile: 919/854-1401